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МОРФОЛОГИЧЕСКАЯ ХАРАКТЕРИСТИКА ВЕГЕТАТИВНОГО МИЦЕЛИЯ И АНАМОРФ У РАЗЛИЧНЫХ КОЛЛЕКЦИЙ КСИЛОТРОФНЫХ БАЗИДИАЛЬНЫХ ГРИБОВ

Изучение морфологических особенностей вегетативного мицелия, в частности анаморф базидиальных грибов является необходимым для исследования их биологии и таксономии. Были проведены морфологические исследования мицелия 27 дикариотических штаммов 22 видов ксилотрофных базидиальных грибов принадлежащих к 15 родам (*Flammulina elastica*, *F. velutipes*, *F. rossica*, *Fomes fomentarius*, *Fomitopsis pinicola*, *Ganoderma adspersum*, *G. lucidum*, *G. resinaceum*, *Hypholoma fasciculare*, *Laetiporus sulphureus*, *Lentinus tigrinus*, *Panellus stipticus*, *Phellinus igniarius*, *Ph. robustus*, *Pholiota alnicola*, *Ph. aurivella*, *Ph. destruens*, *Piptoporus betulinus*, *Pleurotus ostreatus*, *Polyporus varius*, *Psathyrella condolleana*, *Schyzophyllum commune*). У исследованных коллекций были описаны наличие и морфологические особенности гифальных пряжек и петель, анаморф, в частности оидий и хламидоспор, кристаллов, а также кутикулярных клеток. Оценена таксономическая значимость выявленных мицелиальных структур.

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ON THE PHENOLOGY OF LARGER FUNGI IN RAISED BOGS: FIRST YEAR PERMANENT PLOTS MONITORING RESULTS

Introduction. Fungal communities play significant roles in biogeochemical cycling in peatlands globally. Thus, understanding their compositions and community dynamics is crucial towards the sustainable use of these ecosystems. The main roles of fungi in peatlands include the formation of mycorrhizas with most plant species, including trees, shrubs, and some herbaceous plant species, and the decomposition of various organic materials, i.e. litters and organic soil (peat) components. To date, more than 700 taxa of fungi have been described from peatlands globally [10]; however, two bogs in close proximity of each other may contain as many as 350 fungal taxa (unpublished data). Previ-

ous studies of fungal community in peatlands have addressed different fungal guilds, including peat microfungi, fungi on arthropods, freshwater fungi, mycorrhizal fungi, macromycetes, yeasts, chytridiomycetes, and others. The approaches of those studies are similarly varied and include purely taxonomic or diversity studies, fungal biomass investigations, and examinations of capacities of different fungal taxa to decompose specific organic materials. Moreover, previous studies have used a range of techniques to elucidate the diversity of fungi in peatlands, ranging from classical taxonomic approaches to molecular methods [2].

Our studies in the central Taiga of West Siberia so far has consisted of direct observation of fungal fruiting bodies (carpophores) in several peatlands, with a focus on community composition, the quantitative/spatial structure of fungal consortia of different bog plant litters [5], as well as examinations of macrofungal communities [7]. In studying fungal communities, their responses to varying environmental conditions are as important as their community composition. Thus, climatic conditions can influence some aspects of fungal community dynamics in peatlands as well as in other ecosystems, such as upland forests. The nature of the influence of climate on fungal community dynamics is important to understand, given the wide distribution of altered peatlands and the anticipated impacts on peatlands resulting from a changing climate.

The approach to enumerate carpophores in permanent plots has been used previously to gain an understanding of fungal species richness and diversity in ecosystems [9], but, to our knowledge, this approach has not been used in peatlands previously. As such, we initiated a long-term monitoring program for larger fungi fruiting in permanent plots in a bog, with the goal to also elucidate the relationship between carpophore abundance and environmental variables. Long-term monitoring of fungal fruiting dynamics in other ecosystems has indicated a significant relationship between the timing of carpophore formation and some macroclimatic variables, including air temperature and precipitation, which could result in shifts in fungal fruiting patterns as the climate is changing [1, 3]. The influence of these macro–climaticvariables is further complicated by micro-climaticand site–specific variables, including landscape, soil and litter structure, plant community composition, etc., which additionally influence fungal fruiting dynamics. The relationship between environmental and climatic variables and carpophores dynamics has only been addressed in a few studies in peatlands to date [8].

Objectives and methods. We established a series of monitoring plots to study the quantitative and spatial characteristics of macromycete communities in a raised bog in the central Taiga of West Siberia [7]. First-year observations (in 2013) of macromycetes in twenty plots within a 1 km^2 area has shown that there are two distinct communities of fungi corresponding to two distinct vegetation communities (e.g. treed bogs vs. graminoid–*Sphagnum* lawns), which have developed under different hydrologic and micro–climatic conditions. Moreover, our data showed a significant peak in carpophore abundance from the end of August to mid-September in both lawn and treed bog vegetation communities. In an effort to understand better which environmental and climatic drivers influence carpophore development in macromycetes [6], we established a series permanent study plots in this bog as part of a long-term monitoring program.

The long-term monitoring plots were located along a boardwalk near the Mukhrino Field Station of Yugra State University [4] and replaced the previously established plots, which did not have boardwalks near them, thereby eliminating any future impacts to the bog as a result of ongoing research programs. The new plots are located in the same study area and in the same vegetation communities as those from the previous research program. A total of 277 circular 5 m^2 (for a total area of 1385 m^2) long-term monitoring plots were established in May 2014. This total area is nearly evenly divided between the treed bogs and lawn plant communities and incorporates topographic and plant community variation within both plant communities. An area of about 700 m^2 will be sufficiently large to reveal the fungal community diversity within lawns; however, this area will be too small for the treed bogs, as was previously shown [7]. Therefore, we will establish additional monitoring plots in the treed bogs in 2015. The long-term monitoring plots were located 5 m apart in a straight line along the boardwalk, ensuring that plots fell only into "pure", or typical, bog plant communities, i.e. plots were

not established in transitional zones or disturbed areas within the treed bog and lawn plant communities. The plots were visited weekly, and carpophores of different fungal taxa were counted and collected for subsequent identification. Enumerated carpophores were carefully removed from the plots, with the exception of Red Listed taxa, whose carpophores remained untouched.

Climatic and site-specific data (precipitation, air temperature, soil profile temperature, and soil heat flux) were collected from a micro-climate monitoring station established in the Mukhrino bog in 2010. The data were collected at 30 min. or 1 hr. frequencies in one location (precipitation data from a rain gauge) or at several locations in different bog communities (remaining data).

Results and discussions. Fifty macromycete taxa were recorded in the long–term monitoring plots in 2014, which excludes 14 macromycete taxa recorded from this bog in 2013 (four rare taxa from lawns and ten rare to common taxa from the treed bog). Five of the 50 macromycete taxa (or 10 %) were recorded for the first time in the treed bog plant communities in 2014. There were some shifts in the relative abundance of some fungal taxa within each of the two plant community types when comparing the 2013 and 2014 data. For example, *Tephrocybe palustris* and *Galerina tibiicystis* had a higher abundance in lawns in 2014 than in 2013. Conversely, the macromycete community in treed bogs was generally similar in 2013 and 2014, e.g. abundant taxa were similarly abundant in both years, and rare species (here defined as having less than ten records) were similarly rare in both years. Moreover, the number of macromycete taxa recorded only once from the plots was also similar in 2013 and 2014 (five and six taxa, respectively) (table 1).

An analysis of the carpophores abundance during 2014 growing season showed that the first record of fruiting was on 14 June, with an abundance of 65 carpophores/1000 m^2, when the sum of positive mean daily temperatures at the soil surface for the year reached about 300 °C. The last record of fruiting occurred on 17 September, with an abundance of 139 carpophores/1000 m^2. No fruiting had occurred before 14 June (the plots were examined on 31 May and 7 June), and the occurrence of frost on 4, 10, and 14 September initiated the cessation of fruiting in the fall of 2014.

Between 14 June and 17 September, two distinct peaks were apparent for the development of carpophores in the treed bog and lawns, showing a 10-fold difference in the range between minimum and maximum carpophore abundance (from 40 to 393 carpophores/1000 m^2; Figure 1). The first distinct fruiting peak was at the end of June and consisted mainly of carpophores of *T. palustris*, which is parasitic on *Sphagnum* spp. in lawn communities. This peak occurred during a mostly dry period with only light rains and a rise of the mean daily temperature at the soil surface from 11 °C to 17 °C. Fruiting in lawn communities subsided from July to the beginning of September, likely due to elevated water levels in the bog lawns from heavy precipitation events. A small rise in carpophore

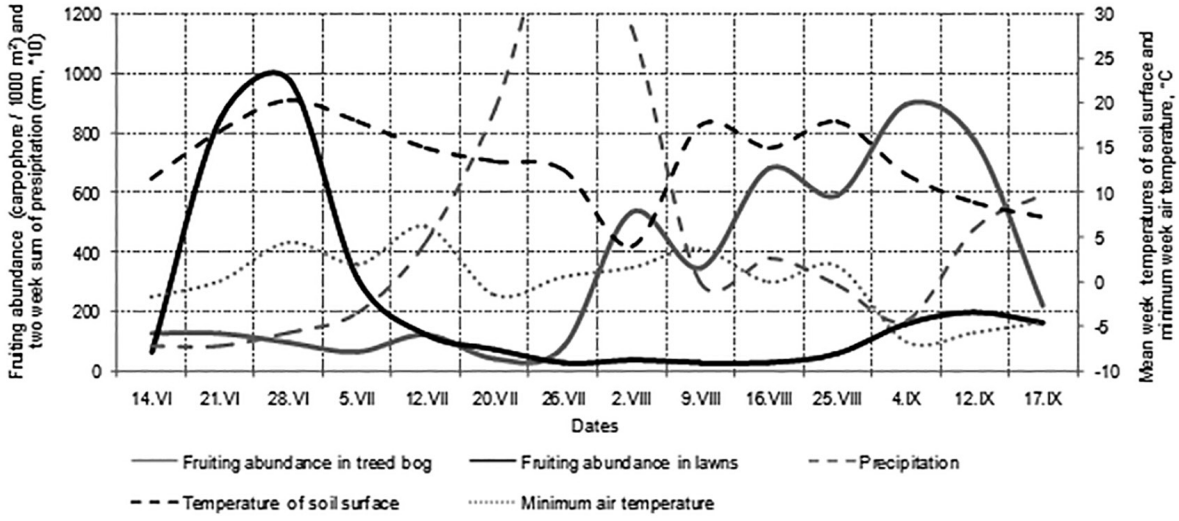

Figure 1. Fruiting dynamics of larger fungi in relation to some climate parameters in long-term monitoring plots in the bog in 2014

Table 1

Fruiting abundance (carpophores per 1000 m^2) of fungal taxa in long-term monitoring plots in the bog (only species with ≥4 records are shown)

Species	Date (2014)													
	14.VI	21.VI	28.VI	5.VII	12.VII	20.VII	26.VII	2.VIII	9.VIII	16.VIII	25.VIII	4.IX	12.IX	17.IX
Pseudoplectania sphagnophila (Pers.) Kreisel	18													
Arrhenia sphagnicola (Berk.) Redhead, Lutzoni, Moncalvo &Vilgalys	16	23	23	16	19	2	1	1						
Gymnopus dryophilus (Bull.) Murril	7	9	4	3	1	1	1	3	3	1	5	6	10	2
Lichenomphalia umbellifera (L.) Redhead, Lutzoni, Moncalvo &Vilgalys	14		5		2					4	1			
Tephrocybe palustris (Peck) Donk	35	418	472	153	54	39		5	14	26	37	30	20	5
Arrhenia onisca (Fr.:Fr) Quel.			5	2	1	3								
Galerina tibiicystis (G.F. Atk.) Kühner			3	7	24	5	18	12	4					
Galerina cerina A.H. Smith & Singer			1				2	147	47	38	11	43	45	10
Galerina paludosa (Fr.) Kühner			2		1		1	1				2	1	
Galerina sphagnicola (G.F. Atk.) A.H. Sm. & Singer					1			2			3	37	49	53
Gymnopilus penetrans (Fr.) Murrill						2	1	1		1	1			
Gymnopus androsaceus (L.) J.L. Mata & R.H. Petersen					14		32	37	4	14	23	6	17	23
Suillus sibiricus Sing.							2	6	7	6				
Thelephora terrestris Ehrh.					1		1		2	1	1	1		
Ascocoryne turficola (Boud.) Korf								1	2	2	3	4	5	5
Cortinarius flexipes (Pers.) Fr.								5		3	3	4	2	1
Cortinarius cf. flos-paludis Melot								2	4	18	14	21	19	2
Galerina sphagnorum (Pers.) Kühner								4	49	60	28	46	54	14
Cortinarius semisanguineus (Fr.) Gillet								13	7	24	12	21	13	2
Sphagnomphalia brevibasidiata (Singer) Redhead, Moncalvo, Vilgalys & Lutzoni								6	1	4	2	1	4	
Hebeloma incarnatulum A.H. Sm.								5	15	15	11	7	6	3
Mycena concolor (J.E. Lange) Kühner								10	10	10	1	3	20	4
Cortinarius cf. albovariegatus (Velen.) Melot										3	8	45	53	20
Cortinarius huronensis Ammirati & A.H. Sm.								1	13	50	44	72	32	8
Cortinarius cf. obtusus (Fr.) Fr.									4	39	94	160	100	25

abundance occurred in the lawn plant community in mid-September, which may be related to a decrease in precipitation or air temperature (Figure 1). The second distinct fruiting peak started at the beginning of August and consisted mainly of carpophores from fungal taxa associated with the treed bog plant community. At this time, the increase in carpophore abundance was related to an increase in precipitation (two-week sum of precipitation reached 150 mm; Figure 1). This second distinct fruiting peak consisted of three sub-peaks from the beginning of August to mid-September, corresponding to a rise in the mean daily temperature one week prior (Figure 1).

The fruiting dynamics of different macromycete taxa is shown in the Table (only taxa with more than four records are shown and addressed here). Fourteen taxa started fruiting at the beginning of

the summer (June and July), with one of them having a very short fruiting season (*Pseudoplectania sphagnicola*). Two taxa (*Arrhenia sphagnicola* and *A. onisca*) were recorded only in June and July, while other taxa more or less continuously fruited until the end of the growing season. Eleven taxa were recorded only in late summer (August and September).

Here we present the first year data of a long–term monitoring program on macromycete fruiting dynamics from two bog plant communities (treed and lawns). Our data show that the abundance of carpophores appears to be correlated to environmental and climatic data, particularly air temperature and precipitation. While these relationships are tentative and purely descriptive at this time, additional data from future years will facilitate the use of robust statistical approaches to elucidate the precise relationship of macromycete carpophore dynamics to environmental data.

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APHYLLOPHOROID FUNGA OF YENISEI MERIDIAN (CENTRAL SIBERIA): FIRST APPROXIMATION IN LATITUDINAL GRADIENT

In Northern Eurasia (western and eastern Europe, the Urals), the species richness of aphyllophoroid fungi, is relatively well studied, whereas the vast territory of Siberia is still a mycological «white spot». Nevertheless, big amount of information was collected from the West Siberia during the last decade, and regular expeditions have enlarged the knowledge also from Eastern and Southern Siberia [2].

The study of aphyllophoroid fungi of the Yenisei's meridian (Central Siberian longitudinal sector) has a long history. The International Transsiberian Mycological Expeditions started already

